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TREATISE
ON
QUARTZ AND OPAL

G.W. TRAILL.

AN
ELEMENTARY TREATISE
ON
QUARTZ AND OPAL

AN
ELEMENTARY TREATISE
ON
QUARTZ AND OPAL,

INCLUDING THEIR VARIETIES;

WITH A NOTICE OF THE PRINCIPAL FOREIGN AND BRITISH
LOCALITIES IN WHICH THEY OCCUR.

BY
GEORGE WILLIAM TRAILL, F.G.S.E.,
EDINBURGH.



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TO

M. FORSTER HEDDLE, Esq., M.D.,

PROFESSOR OF CHEMISTRY, UNIVERSITY OF ST. ANDREWS,

This Elementary Treatise

IS, BY PERMISSION, RESPECTFULLY INSCRIBED

BY

HIS FAITHFUL AND OBLIGED FRIEND,

THE AUTHOR.

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P R E F A C E.

THE minerals Quartz and Opal, owing to their great variety and beauty, hold a prominent place in most collections, and are well suited to form an independent treatise. A work of the kind must necessarily, to a certain extent, be compiled from general sources, yet a considerable amount of the following Treatise will be found strictly original, the Author having devoted his attention principally to this branch of the science; and care has been taken to assert nothing as fact but what has been well authenticated.

The Author is much indebted to the very complete lists of British localities contained in Greg and Lëttsom's "Manual of the Mineralogy of Great Britain and Ireland;" also, personally, to Professor Heddle of St Andrews, for much general information, and for his kindness in affording fréquent access to his extensive and valuable collection of minerals.

EDINBURGH, October 1866.

LIST OF WORKS

CONSULTED OR REFERRED TO IN PREPARING THE FOLLOWING
TREATISE.

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ERRATA.

- Page 33, line 18, *for their read thin.*
" 37, " 15, *for complimentary, read complementary.*

ELEMENTARY
TREATISE ON QUARTZ AND OPAL.

QUARTZ.

QUARTZ is composed of pure silica, generally combined with minute proportions of metallic oxides, from whence the varied and brilliant colors it frequently exhibits are derived. It is a most abundant mineral, forming extensive veins and masses in primitive and transition rocks, and, consequently, diffused over almost every quarter of the globe. It is an essential constituent of granite, gneiss, mica-slate, and other allied rocks; and, in the form of sand, forms nearly the whole of the mobile soil of the sterile desert. In South America quartz has been observed by Humboldt in mountain masses or beds many hundred feet in thickness. Its specific gravity varies from 2.5 to 2.8; and is 2.65 in the purer varieties. Quartz consists of many varieties, differing much in external appearance; all of which readily scratch glass, and equal 7 in Professor Mohs' scale of hardness. It is infusible *per se* before the blowpipe; but with soda, fuses with intumescence into a transparent glass: and is insoluble in all acids, excepting hydro-fluoric acid. When pulverized, is slightly soluble in a solution of caustic potash. Quartz occurs massive and crystallized; also fibrous, stalactitic, granular, spongiform, pseudomorphous, &c.

B

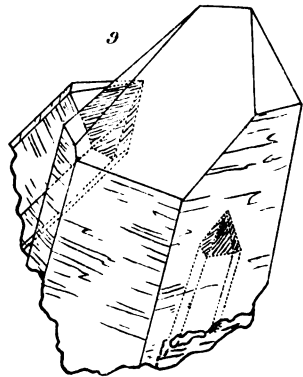
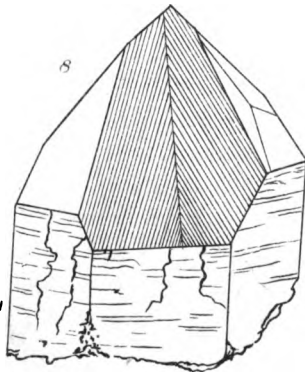
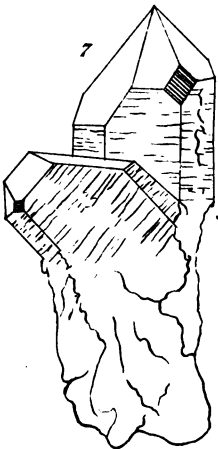
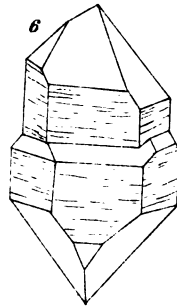
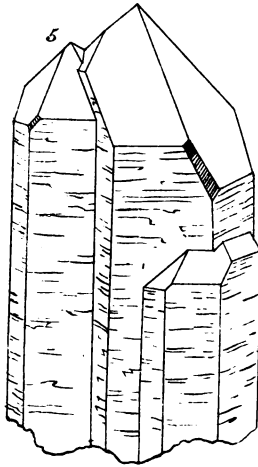
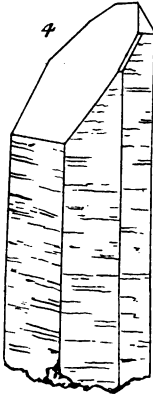
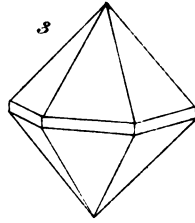
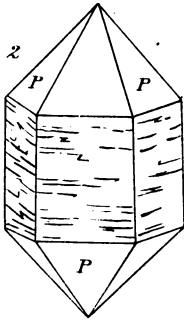
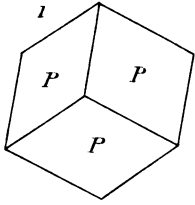
CRYSTALLIZED QUARTZ. ROCK CRYSTAL. Dragonite. Quartz, *Phillips, Brooke and Miller, &c.* Quartz, *Hauy, Naumann, Werner, Haidinger, Hausmann.* Rhombohedral Quartz, *Mohs.* White-stone of the jewellers. Berg Crystal.

Silica	99.37
Alumina	trace
	—
	99.37 Bucholz.
	—

Sp. Gr. 2.653 Beudant.

Rock crystal is the name usually given to crystallized quartz when pure and colorless. The primary form of the crystals is a rhomboid, fig. I.; but these are of rare occurrence, and are always small. The usual form is a hexagonal prism, terminated by hexagonal pyramids, fig. II.; or, less frequently, the double hexagonal pyramid, fig. III. Crystals, however, are seldom so perfectly regular as figures II. and III. One or more of the pyramidal faces is generally enlarged at the expense of the others; and sometimes one face almost entirely extinguishes the rest, as shown in figure IV.;—this form is common in the fine transparent groups from Dauphiné and elsewhere among the Alps. The primary pyramid P, has the middle edge = $103^{\circ} 34'$, and the polar edges = $133^{\circ} 44'$. Frequently, however, it appears as a rhombohedron, with polar edges = $95^{\circ} 15'$. The faces of the pyramids are smooth and polished, while the prisms are generally striated horizontally;—these striæ being the result of a frequent alternation between prismatic and pyramidal faces during crystallization.

Crystals of quartz are seldom isolated; most generally they occur in groups, crossing and penetrating each other, and often forming beautiful cabinet specimens. They are sometimes grouped with the axial system of the individuals parallel, fig. V.; or occasionally as re-



presented in fig. VI. ; less commonly penetrating each other, presenting the appearance of a simple crystal, fig. VII. Figure VIII. represents a twin crystal from Hudson's Bay, exhibiting minute striæ on one of the pyramidal faces. Figure IX. represents a crystal in the author's cabinet, in the interior of which two other crystals of quartz are distinctly visible, without the superposition of chlorite or other foreign substance;—in this instance the pyramids of the enclosed crystals are striated, while the prisms are smooth, with a slightly blistered appearance. Rock crystal has a conchoidal and splintery fracture, and a vitreous to splendid lustre. The fracture, perpendicular to the axis, often presents the lustre of velvet, as first observed by Brewster. Rock crystal exhibits double refraction and circular polarization. On rubbing two pieces together in the dark a phosphorescent light is produced, and an empyreumatic odor at the same time emitted: this phosphorescence is also seen under water.

Crystals sometimes enclose foreign minerals, and such specimens are occasionally of great beauty, and are highly prized. Among the minerals which have been observed are, capillary crystals of epidote, rutile, limonite, actinolite, tremolite, asbestos, schorl, beryl; crystals of mispickel, kyanite, iron pyrites, antimony glance, cassiterite, magnetite, topaz, calc-spar; thin scales, or filaments of mica, pearl-spar, native silver, native copper, native gold, silver glance, anthracite, bitumen; and, more rarely, drops of water, naphtha, and a very expansible transparent liquid. Sir D. Brewster mentions a specimen from Quebec, containing a cavity with fluid, in which is a loose group of calc-spar crystals which moves through the fluid on turning the specimen. According to Sir Humphry Davy, the fluid contained in rock crystal generally consists of water, with a minute quantity of saline matter; and the expansible fluid is azote. Quartz crystals are sometimes so thoroughly intermingled with chlorite as to appear wholly composed of this mineral; and their hardness is much re-

duced in consequence. The capillary crystals of rutile in rock crystal sometimes occur of a bright red color, and such specimens were formerly known by the name of *Venus-hair-quartz*; and are supposed to be identical with the *Veneris crines* of Pliny; and the *chrysothrix*, or golden hair, of the Orphic Poem.

Crystallos, a name which expresses both ice and crystal, was first given to this mineral by the Greeks.

It was the common opinion of the ancient naturalists, and the belief has, indeed, been prevalent almost to our own time, that rock crystal was nothing else but ice or snow congealed to hardness by long continued and intense cold. Pliny is positive in this opinion:— "*Crystallus fit gelu vehementius concreto.*" Diodorus Siculus, on the contrary, supposes it was water solidified by the power of solar heat:— "*Crystallum esse lapidem ex aqua pura concretum, non tamen frigore sed divini caloris vi.*"

Rock crystal was made into drinking vessels by the ancients, which proves in their lapidaries a high degree of skill.

Some crystals attain an immense size. There is one in the Museum at Paris 3 feet in diameter, and weighing nearly 8 cwt. Allan mentions a group of crystals in the University Museum at Naples, weighing nearly half-a-ton, and another at Milan, 3½ feet long, and 5½ in circumference, estimated to weigh 870 lbs. About a century ago, a drusy cavity was opened at Zinken, which afforded 50 tons weight of rock crystals, and at that early period sold for £60,000. One of the crystals weighed 800 lbs.

Rubasse is the name given to rock crystal, colored red artificially by repeatedly heating the specimen, and plunging it into a solution of cochineal. By this process the stone becomes full of small fissures, which absorb the coloring matter. It is produced of other colors also, by substituting saffron, indigo, or other ingredients, though the same name is applied to all:—the red color is, however, pre-

ferred. *Natural rubasse* occurs in the Brazils, but is very rarely met with.

The finest specimens of crystallized quartz occur in Savoy, Switzerland, Tyrol, Piedmont, and elsewhere among the Alps, forming drusy cavities in mica-slate; at Barèges, and in several parts of the Pyrenees; in Siberia, Mount Caucasus, Schemnitz in Hungary, and Ceylon. Very large crystals have been brought from the Brazils, and Madagascar. Beautifully limpid crystals occur imbedded in the primitive marble at Carrara, and in the Keuper marls of Lippe; and brilliant specimens have been brought from various localities in North America, such as, Lake George, Cape Diamond near Quebec, crystals from which latter locality frequently contain fluids, the southern shores of Hudson's Bay, &c. Crystals having the primary form occur in jasper, near Warwick. Fine dodecahedral crystals are obtained at the beds of specular iron in Fowler, Hermon, and Edwards, St Lawrence Co., New York. Crystals with rounded angles, as if they had been partially fused, occur in limestone at Gouverneur. At Palatine, Montgomery Co., crystals occur having one end terminated with the usual pyramid, while the other is rounded and smooth. Large crystals, often perfect, and weighing several pounds, occur at Minnesota mine. Lake Superior:—metallic copper occasionally envelopes these crystals as if it had been cast around them. Limpid specimens are sometimes brought from China, containing imbedded minerals, or carved with much skill into drinking-cups, idols, &c., and are highly valued.

Good specimens of rock crystal are found in many parts of Great Britain. The following localities may be enumerated:—

Cornwall; at the Tintagel slate quarries, and in the cliffs there, in clear crystals, fit for ornamental purposes. In the cliffs at Delabole, near St Teath. At Swanpool. Enclosing schorl at Boscawen cliff, near Penzance. At Mainforth, near Falmouth.

Cumberland; at Brandygill, Tentergill, and Potsgill, on Carrock

Fells. At Caldbeck Fells; and at Falcon Craig, near Keswick. At Alston; and in fine clear crystals on hematite at Cleator Moor iron-mines. *Capped quartz* occurs at Carrock Fells.

Devonshire; in fine crystals five or six inches long, containing chlorite, and studded with smaller crystals around the base in the manner of a ruff. At Wheal Friendship, near Tavistock. At North Bovey, in large opaque reddish crystals. *Babel quartz* occurs in Devonshire.

Derbyshire; at Castleton, with blende, At Masson Low, or Heights of Abraham.

Gloucestershire; at Clifton, known as "British Diamonds."

Isle of Wight; at Sandown, and Brixton Bays, in rolled pebbles of great purity, which have been washed out of the Wealden deposits at these localities.

Lancashire; at the Ulverston iron-mines with haematite.

Northumberland; at Allenheads.

Shropshire; at Snailbeach, with calcite.

Somersetshire; at Cheddar in geodes.

Kent; in the "Caller" flint nodules in chalk-pits, near Canterbury. At Tunbridge Wells, in limpid pebbles, fit for ornamental purposes.

Wales.—Carnarvon; at Snowdon, very fine.

Scotland.—Argyleshire; in the primary form, on the north shore of Holy Loch; at Ballygroggan, Mull of Cantyre, in fine doubly pyramidal crystals in trap rock. In the neighbourhood of Cairngorm, Banffshire, in fine crystals usually wine-yellow or brown: sometimes black. These crystals are much sought after for ornamental purposes.

Ireland.—Antrim; at Knocklayd Mountain, near Ballycastle. Colorless crystals at Divis Hill, near Belfast. Near Carlow. In Donegal, very fine. Downshire; beautifully crystallized with topaz and beryl, generally dark brown, or black, in clefts and cavities of the granite at Mourne Mountains. Dublin Co.; at Howth, in marl.

Yellow at Palmerston. Kerry; at Killarney, in yellow detached crystals; in sandstone at Mulloch Veil. Kilkenny; in large crystals at Castle Comer. Londonderry; in the parishes of Upper and Lower Cumber. Very fine at Dungiven, parish of Banagher; also at Finglen Mountain, close to Dungiven;—at all of which localities it occurs in large detached crystals of a yellow, or smoky color, imbedded in the soil. They are known locally by the name of *Dungiven crystals*, and sometimes are very perfect;—one has been found at Dungiven, weighing nearly 90 lbs. At Rovenach, near Newtown-Limivady. At Blasquet Island, Co. Kerry. Tyrone; in the parishes of Donaghmore and Tullyniskan, in large detached crystals. Yellow at Glen Malur, in Wicklow.

VIOLET QUARTZ.—AMETHYST. Quarz hyalin violet, *Hawy*.

Silica	97.50
Alumina	0.25
Peroxide of iron	0.50
Oxide of manganese	0.25

98.50 Rose.

The color of amethyst is by some mineralogists supposed to be derived from a small percentage of oxide of manganese; but it would seem by the analyses of Heintz and Poggendorff to be due to the presence of a minute quantity of ferric acid. Amethyst loses its purple color by long exposure to heat.

The color is often irregularly diffused; and portions of specimens are sometimes colorless. This is well described by Pliny:—“*Ad viciniam crystalli descendet albicante purpuræ defectu.*”

The fracture presents numerous delicate ripple lines, somewhat resembling those observable in the palm of the hand; and all speci-

mens of rock crystal having this peculiarity, whatever be their color, are now classed as amethyst by mineralogists. This fracture is due, according to Sir David Brewster, to the crystal being composed of layers; and these layers are found to have opposite optical properties.

The amethyst was valued by the ancients, on account of the property their superstition attached to it of preserving from intoxication any person by whom it was worn :—when adorned with figures of the sun or moon, it was worn as a charm against poisons. The name is derived from the Greek *α*, not, and *methusos*, drunken. There are in collections many finely engraved specimens regarded as antiques, frequently sculptured with the head of Bacchus. This is not, however, the only amethyst of the ancients; the violet-colored sapphire, violet fluor spar, and probably several other minerals being designated by the same name.

Amethyst, like most other gems, appears less brilliant by gas light; and is seen to best advantage when surrounded with pearls and set in gold.

The best violet amethysts are brought from Ceylon, Silesia, Siberia, the Brazils, the kingdom of Murcia in Spain, Persia, and Cambay in India, where they occur in geodes, or hollow balls lined with crystals, and as pebbles. They occur also, though of less beauty, in Sweden, the Hartz, Bohemia, Porkura and Siebenburg in Transylvania, Oberstein in Germany, Kapnik in Hungary; at Guanaxuato in Mexico; at Lake Superior, Pennsylvania, and elsewhere in North America; and in Great Britain at the following localities :—

Cornwall; at Wheal Buller, and Wheal Tolgus, near Redruth. Wheal Bellon, near St Just. Wheal Cock. Wheal Alfred. St Cleer, near Liskeard. Bosaverne mills. Levant mine, St Just. St Ewe parish, four miles S.W. of St Austell. Nangisel Cove, Sannen, near Land's End, in drusy cavities. Wheal Uny, near Redruth. Wheal Hope, near Truro.

Devon ; at Oakhampton. Radiated at Whitchurch Down.

Gloucestershire ; at Clifton, very fine, penetrated by lance-like crystals of hydrous oxide of iron, which sometimes project half-an-inch ; also at Providence iron-mine, one mile and a-half S.W. of Clifton.

Somersetshire ; parish of Cheddar, two miles S.W. of Axbridge, in nodules.

Scotland.—Haddingtonshire, on the coast in trap, opposite the Bass Rock. In the cavities of agate in Fife, Perth, and Forfarshire.

Ireland.—County Cork ; near Cork, at a quarry on the bank of the Lee, in very fine crystals. Mayo ; Achill Island, in fine translucent crystals, occasionally 8 or 10 inches long. Meath ; near Navan, of a pale color. Also in Dublin Co. ; at Kerry Head ; in Leitrim. In the Hebrides ; in Lewis, and North Uist.

ROSE QUARTZ.—Quarz hyalin rose, *Hauy*.

The color of rose quartz is due, according to Fuchs, to the presence of from 1 to 1.5 per cent. of oxide of titanium. Some mineralogists, however, attribute it to manganese ; while Berthier states that the coloring matter of the variety from Quincey is of organic nature. The color becomes much paler when the stone is long exposed to light. Rose quartz is rarely found crystallized. The fracture has a peculiar fatty lustre. When cut and polished it forms a handsome ornamental stone, but specimens are seldom sufficiently free from cracks to admit of being used in jewellery. The larger masses are wrought into vases and other objects of art.

Milky Quartz, Quarz hyalin laiteux, *Hauy*, is distinguished from the former by its color only, which, as its name denotes, presents a milky aspect. Some specimens are slightly opalescent. It is only found massive, and is uncommon.

The principal locality of rose quartz is at Rabenstein, near Zwiesel, in Bavaria, where it occurs in a vein of manganese traversing a coarse-

grained granite. Very fine specimens occur at Kolyvan in Siberia. It is also met with, but of less beauty, at Abo, in Finland; at Ekaterinburg; in the Palatinate; in South Greenland; at Southbury, Connecticut, Williamsburg, Massachussets, and elsewhere in North America; and at the following British localities:—In Aberdeenshire, on the hills of Kildrummy, Auchindoir, and Glenbucket. In fine specimens on the shores of Kirkness in Shetland. Opalescent and pink at the Island of Shiant, Hebrides. In the Island of Coll. Also near Belfast, in small detached crystals.

BROWN QUARTZ.—Smoky-quartz. Quarz hyalin enfumé, *Hauy*.—This variety occurs of various shades of brown and greyish-brown, passing into black;—when black it is called *morion*. The color is due to a minute portion of oxide of iron. It is much used in jewellery, and usually called *Cairngorm* by lapidaries, owing to fine specimens being found in the vicinity of Cairngorm in Banffshire. An Edinburgh lapidary cut nearly £400 worth of ornamental stones out of a single crystal from this locality. India, Brazil, Mexico, Bohemia, Olivet, near Orleans, and Pennsylvania, now produce the finest specimens. It is found in Britain at the Carnbrae Mines, Cornwall, in the vicinity of Cairngorm, in Banffshire, and at several of the localities of rock crystal.

Under this head may be noticed *Yellow quartz*, quartz-hyalin-jaune, *Hauy*, which is generally artificially produced by submitting the dark varieties of brown quartz to a certain treatment with heat: they become nearly transparent; assume several shades of yellow, passing into reddish-brown; and are extensively employed in jewellery, under the names of *citrine*, *false-topaz*, *occidental-topaz*, *false-hyacinth*, &c., according to color. Some specimens much resemble yellow topaz, but may be distinguished by their inferior specific gravity and hardness. Quartz seldom occurs yellow in the natural state.

BLUE QUARTZ.—Siderite. Lenco-sapphire? *Pliny.*—Blue quartz occurs in fine specimens of a Berlin-blue color at Golling, near Salzburg; also, massive, at Pednandrea mine, near Redruth, and at North Roskear, in Cornwall; and in Cumberland.

RADIATED QUARTZ occurs in closely aggregated crystals, which radiate from a point. It is found in small fibrous tufts on red Heulandite at Campsie Hills, S. Stirlingshire; at Salisbury Crags, Edinburgh; in the amygdaloid of the Kilpatrick Hills near Dumbarton, (the *Kilpatrick-quartz* of Thomson), in fine specimens, generally of a pale flesh-red color, associated with natrolite and other zeolites, at Holly Park, near Rathfarnham, S. Dublin. Radiated quartz is not uncommon in Cornwall, especially in cross-courses, hence it is sometimes called by the miners *cross-course-spar*.

FIBROUS QUARTZ is produced when the composition presents thin columnar particles. *Cat's-eye* is a variety of this interspersed with parallel fibres of amianthus, which produce a peculiar opalescence when the stone is cut *en cabochon*. It is generally translucent; is usually of a yellowish, or greyish-green color; but also brown, of a deep orange, and sometimes even nearly black. It is a gem much valued in the East, and is frequently employed in jewellery.

Cat's-eye is supposed to have been known to the ancients, and is probably identical with the *Beli oculus* of Pliny.

Its principal localities are Ceylon and the Malabar coast. It has been brought from Orange River near the Cape of Good Hope; from Treseburg in the Hartz, and Hof in Bavaria. A pale green variety occurs with epidote in the Vale of Llanberris, near Carnarvon.*

* Fibrous quartz occurs in fine specimens at Bodenmais in Baiern.

GLOBULAR QUARTZ occurs at Knockmahon copper-mines near Bunmahon, S. Waterford; and of a black color, in chalk, at Dover.

STALACTITIC QUARTZ occurs at Wheal Alfred, Cornwall. At Clifton, near Bristol. In very fine specimens at Kinnoul Hill, Perthshire. At the Giant's Causeway, Antrim, of a brown color.

FLOAT STONE.—Schwimmkiesel, *Hausmann*. Schwimmstein, *Werner*. Quarz Nectique, *Hauy*.

	<i>a.</i>	<i>b.</i>
Silica,	85.9	98.0
Alumina,	0.7	...
Carbonate of lime,	9.1	2.0
Water,	3.3	...
	<hr style="width: 50%; margin: 0 auto;"/> 99.0	<hr style="width: 50%; margin: 0 auto;"/> 100.0

a, by Count Schaffgotsch : *b*, by Vauquelin.

This is a light porous variety of quartz of a greyish-white color, which possesses the property of floating on water until the air contained in its numerous cavities is expelled. It consists, according to Ehrenberg, chiefly of the siliceous coverings of infusoria. It occurs at St Ouen, near Paris, in beds of flint in chalk, and on the banks of the Seine; also in Cornwall at Wheal Alfred.

CELLULAR QUARTZ, a spongiform variety of the above, of a reddish-brown colour, is found in Cornwall at Relistian mine, four miles S.W. of Camborne; at Cardrew mine, and at Pednandrea. Fine specimens have been brought from the Cape of Good Hope. A singular cellular or honey-comb variety of a dark grey color has been met with at Alston, Cumberland, and Teesdale, Durham; probably the skeletons of decomposed septaria.

PSEUDOMORPHOUS QUARTZ.—Quartz is said to be *pseudomorphous* when it assumes forms peculiar to the crystals of other minerals. The term is derived from the Greek,—*Ψευδος*, signifying false; and *μορφη*, form or figure.

It occurs *in the form of lenticular crystals of gypsum* at Montmartre, near Paris.

In the form of calc spar:—in Pennsylvania; at Schemnitz, Hungary; at Fontainbleau, France, in rhombohedrons; at Schneeberg, in Saxony; at Clifton, near Bristol; in Cornwall, at the Gwennap mines; in tabular crystals at Botallack, and lately at the Consolidated mines, near St Ives. Formerly at the Haytor iron-mine, Devonshire.

Cubic and octahedral in the form of fluor or pyrites:—in Westhampton, Massachussets; at Eibenstock and Schwarzenberg, in Saxony; in Cornwall at Wheal Alfred; Carnbrae; Balleswidden, St Just; Wheal Spearn, St Iyes; Wheal Sparnon, near Redruth; North Roskear; Camborne; in fine specimens, lately, at Trehane, Menheniot; at Great Crinnis; Wheal Herland, near Hayle; at Perranzabuloe. Octahedral at Holmbush mine, Callington; also at S. Caradon, St Cleer. In Devonshire, at Beeralston and Beerferris; also at South Hoo mine. In Gloucestershire, near Bristol, in sandstone, in small cubic crystals. In Cumberland, at Alston and Nenthead, capping fluor: similarly at Allenheads and Wheal Allendale, Northumberland, and Weardale, Durham.

In the form of Barytes, probably, in Rutherford Co., North Carolina, often filled with water; at Leadhills, Scotland.

In the form of Iron glance, at Ifeld, Hartz.

In the form of analcime, at Fundy Bay, Nova Scotia.

In the form of dichroite?, at Obergebirge, Saxony.

In the form of scapolite, at Arendal, Norway.

In the form of pearl-spar, at Levant mine, near St Just, Cornwall.

In the form of stilbite, at Kilpatrick, Scotland.

In the form of Anglesite, psilomelane, and galena, at Leadhills.

Hacked Quartz occurred lately very fine at Herodsfoot mine, near Liskeard, Cornwall.

SILICEOUS SINTER. Kieselsinter, *Werner*. Geyserite, *Damour*.
Quarz Agathe concretionnée thermogène, *Hawy*. Geisersinder. Opale
incrustante. Tuf du Geysir. Keiseltuff.

	<i>a.</i>	<i>b.</i>	<i>c.</i>	<i>d.</i>	<i>e.</i>
Silica, . . .	98·0	94·01	84·43	93·25	94·0
Alumina, . .	1·5	1·70	3·07	2·00	2·0
Perox. of Iron,	0·5	...	1·91	1·25	...
Magnesia, . .	...	...	1·06	...	...
Lime, . . .	...	...	0·70	...	4·0
Potash and Soda, ...	...	...	0·92	...	...
Water, . . .	...	4·10	7·88	3·00	...
	<u>100·</u>	<u>99·81</u>	<u>99·97</u>	<u>99·50</u>	<u>100·</u>

a, *b*, and *c*, from the Geysir, Iceland, by Klaproth, Kersten, and Forchhammer, respectively:—*d*, from Kohren, in Saxony, by Zellner:—*e*, the pearl sinter of Santa Fiora, by Santi.

Sp. Gr. about 1·8.

Siliceous Sinter is an opaque brittle mineral of a greyish-white color, and dull or glimmering lustre, occurring abundantly around, and deposited by, the intermittent boiling fountains called the Geysers, in Iceland, in whose waters it is held in solution. It also occurs in New Zealand, at the hot springs of Roturua, around the crater of the volcanic mountain of Tongariro; in small quantities at the Suanna spring in Florida; and at other hot springs near volcanoes. The solvent power of these hot fountains and springs is due to their high

temperature, and to the presence of a small quantity of alkali. Siliceous sinter is infusible *per se* before the blow-pipe. It is commonly porous. The structure is usually fibrous, although sometimes lamellar, and arborescent. Specimens often enclose the stems and leaves of plants which have been growing around the springs at the time the mineral was deposited.

Fiorite, or *Pearl sinter*, is a variety of the above, occurring in smooth botryoidal, stalactitic, and globular masses of a white, or greyish-white color, and pearly lustre; not so hard as quartz; and infusible *per se* before the blow-pipe. It is found in the cavities of volcanic tufa at Santa Fiora, near Florence, hence the name Fiorite; in volcanic tufa and pumice in the Vicentine, and in other volcanic districts of Italy; also in Auvergne.

FULGURITE.—Astrapyalite. Sand-tubes. Blizsinter. Ceraunian-sinter.

Fulgurites are vitrified tubes formed by the action of lightning on sand. They are of a grey color; and are irregular and rough on the exterior, being incrustated over with grains of sand; but in the interior are smooth and glassy. They are usually three or four inches in length; but occasionally from four to six feet, and divided into several branches.

They occur at the Senner and Lüneburg Heaths, North Germany; also occasionally in the sand and sand-hills on the coasts of Cumberland and Lancashire. They have been formed at Paris in tubes an inch long by means of the discharge of a powerful electric battery.

SAND.—The white variety is nearly pure quartz in a granular state: such is the sand at Headon Hill, on the north side of Alum Bay, Isle of Wight, largely used in the manufacture of glass, and oc-

curring in great purity in a bed of from 30 to 50 feet thick. Other localities are at Lynn, on the coast of Norfolk; in the caverns of Reigate, in Surrey; at Ard, near Salt Lough, N. Donegal.

A variety of sandstone, remarkable for its flexibility when cut in thin slices, occurs near Villa Ricca, in Brazil; in very fine specimens at Jujjur, about 120 miles N.-W. of Delhi; and in the North Carolina gold region. This property appears to arise from small scales of mica interspersed throughout its mass.

AVANTURINE. — Quartz hyalin aventurine, *Hawy.* Sandaster?, *Pliny.*

This is a variety of massive quartz of a fine granular structure, containing numerous small scales of mica usually of a golden color, which, when polished, presents a shining spangle-like appearance. There is another variety, in which an effect somewhat similar is produced by the reflection of light from an infinity of small fissures disposed throughout the mass. The most common color is a reddish brown; but it also occurs yellow, grey, greyish-blue, and green.

This variety of quartz is supposed to have been known to the ancients, and is probably identical with the *sandaster* of Pliny.

Avanturine is often imitated in glass, and the artificial production far exceeds the natural in brilliancy.

The finest specimens are brought from India. It also occurs at Cape de Gatte, and Arragon, in Spain; red, also white with silvery specks; at Face Bay, in Transylvania, black with golden-colored specks; in Lower Brittany, in rolled pebbles; in some parts of the Alps; in Siberia; in Greenland, of a fine green tint; and, according to Dr M'Culloch, at Glenfernat, in Atholl, N. Perthshire, of a fine greyish-blue.

PRASE.—Quarz hyalin vert-obscur, *Hauy*. Prasius, *Pliny*.

Silica,	94·84
Alumina,	0·47
Protoxide of iron,	3·64
Water,	1·05

100·00 Beudant.

This variety is of a dark leek-green color, which it derives from an admixture of amphibole. It is generally opaque, and seldom occurs crystallised. The name is derived from the Greek, *prason*, signifying a leek, in allusion to its color.

Prase is spoken of by Pliny as a green stone of inferior rank :— that other kind he mentions as being “*sanguineis punctis obhorret*” was probably heliotrope.

It occurs in the iron mines of Breitenbrunn, near Schwartzenberg, in Saxony; in Tuscany; in Bohemia; at Kupferberg, Silesia; in the Hartz; in fine crystals at the Cedar Mountain in South Africa; also in Cornwall, at North Roskear, and at Wheal Bellon, near St Just; at Falcon Craig, near Keswick; and in quartz veins in the Island of Bute.

FERRUGINOUS QUARTZ.—Hyacinth of Compostella. Sinople. Iron-flint, *Jamieson*. Eisenkiesel, *Werner*. Quarz hyalin rubigineux, *Hauy*.

Silica,	94·93
Alumina,	0·42
Peroxide of iron,	3·93
Water,	0·73

100·01 from Sundvig, by
Schnabel.

D

This variety occurs both crystallized and massive; presents several dull shades of yellow, red, and brown; and is generally opaque. It contains usually about 5 per cent. of red or yellow ochre, or G \ddot{o} thite. It forms the transition to jasper. The crystals are always small; the largest rarely exceeding an inch in length. Magnetic properties are, according to Jackson, produced in some specimens by heat.

Ferruginous quartz is found at St Jago de Compostella, Spain, in very perfect distinct crystals imbedded in gypsum; in Bohemia; in ironstone veins in the Hartz; in Hungary; at Altenburg, Johann Georgenstadt, Freyberg, and Eibenstock, in Saxony; at Sundvig, Westphalia; and at the following British localities:—Botallack and Marazion, in Cornwall. With common quartz and haematite at Clifton. In geodes in new red sandstone at Churchill. On Skiddaw, Cumberland. In the neighbourhood of Bristol. At Stockingmoor, near Glasgow. In trap at Dunbar, N.E. of Haddingtonshire. In minute crystals of a yellow color, also massive, at Benbradagh Hill, near Dungiven, Londonderry. In trap at Rathlin Island, N. Antrim.

JASPER.

JASPER.—Jaspis, *Werner*. Quarz Jaspe, *Hauy*.

Silica	93·57	95·76
Peroxide of iron	3·98	2·74
Alumina	0·31	1·50
Lime	1·05	...
Water	1·09	...

100·00	Bendant	100·00	by Walchner, from Kandern.
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This is a ferruginous compact variety of quartz, presenting various

shades of red, brown, yellow, and green; in irregular patches, and sometimes in stripes. It has a conchoidal fracture; is dull and opaque,—its fragments being seldom translucent on the edges;—and does not fuse before the blow-pipe. It is a common mineral, distributed in veins and beds both in primitive and secondary mountains.

We are uncertain what particular minerals were denominated iaspis by the ancients; but it is evident to all who are acquainted with the subject that they classed together under that name several totally distinct species. Pliny says it is a green stone, and often translucent. In another place, he speaks of a kind found in Persia resembling in color an autumnal morning sky, and hence called aërizusa. Beckmann supposes this to have been blue jasper; but as blue jasper, if it can properly be said to occur of this color, is very rarely met with, more probably it has been lapis lazuli, of which the finest specimens have been for long brought from Persia and the East.

Jasper admits of a high polish, and is often manufactured into vases, boxes, knife-handles, and the like. It is found in many parts of the Continent. A variety bearing some resemblance to Egyptian jasper occurs in the pea-ironstone at Auggen and Kandern, Baden, presenting certain shades of yellow and red disposed in patches and annular markings. It occurs blood-red in the Tuscan Appenines, Piedmont, Sicily, &c. Variegated jaspers occur of great beauty at Giuliano, and elsewhere in Sicily. A white variety, diversified with crimson veins, is said to occur in Syria.

Among the British localities of common jasper, the following may be enumerated:—

Cornwall; at Botallack, Cape Cornwall, Wheal Sparnon, Wheal Maudlin, Wheal Unity, and at Tregos, four miles S.E. of St Colomb Major.

Devonshire; at Ivy Bridge.

Dorset; Isle of Portland.

Isle of Wight ; at Sandown and Brixton Bays, in rolled pebbles.

Cumberland ; at Falcon Craig.

Yorkshire ; at Scarborough, and near York.

Scotland ; at Dunglass, S. Dumbarton ; Campsie, Kilsyth, and Killearn, Stirlingshire, at the former of which localities it occurs in very fine specimens, usually red and yellow, mottled,—and occasionally of a uniform bright red color ; near Montrose ; Habbie's Howe, Pentlands ; Carlpos ; Roxburghshire ; Moorfoot Hills ; Arthur's Seat, Edinburgh ; East Linton, Haddingtonshire, of a bright yellow ; Isles of Isla and Rum, Argyll ; sap-green at Iona.

Ireland ; abundant in the Cushendell porphyry, Antrim ; also in the older conglomerate of Tyrone ; at Lough Erne Head, Fermanagh ; of a deep red at Slieve Gallion, Londonderry ; in Wicklow.

RIBBON JASPER presents various shades of green, red, and yellow, in parallel stripes or layers. These layers, being generally very regular and well defined, enable lapidaries to engrave the stone as a cameo, in the same manner as the onyx. The finest specimens are found in the Ural mountains of Siberia. It also occurs in Bohemia ; at Gnadstein, in Saxony ; at Ivybridge, in Devonshire ; at Dressing Green, near Tortworth, Gloucestershire ; in Perthshire ; at Ballygroggan, Mull of Cantyre.

EGYPTIAN JASPER occurs in roundish or reniform nodules, externally of a brown color, and rough : internally exhibiting various shades of yellow and brown, arranged in irregular concentric zones, or in patches. It occasionally presents dendritic appearances. The markings in some specimens have a resemblance to natural objects, such as plants or animals. In the mineral department of the British Museum, room 3, case 23, is a small specimen, broken in two, each piece of which bears, it is said, a correct profile of the poet Chaucer.

The same peculiarity is sometimes observable in flint and other minerals, and such specimens are held in high estimation by the curious. Stones possessing these appearances formerly went by the name of *Gamahées*.

Egyptian jasper is found, according to Dr Clarke, abundantly scattered over the surface of the desert eastward of Grand Cairo. Rolled specimens of jasper, having some resemblance to the Egyptian variety, are met with at Sandown and Brixton Bays, Isle of Wight: these specimens appear to have been washed out of the Wealden strata.

PORCELAIN JASPER, as it is called, is merely clay-slate indurated by intense heat. It is quite distinct from true jasper, from which it may readily be distinguished by its fusibility on the edges before the blow-pipe. It is compact and opaque; has usually a slaty structure, with an uneven fracture; and has generally either a bluish-grey, or a light fawn color. It is met with chiefly in the vicinity of coal mines which have been in a state of combustion. Occurs at Aussig and Carlsbad, in Bohemia; at Planitz, near Zwickaw, in Saxony; near St Etienne; at Duttweiler, near Sarrbrück; also in Madeley parish, two miles N.E. of Broseley, E. Salop.

HORNSTONE, or **CHERT**, occurs massive and compact; has a smooth conchoidal, or splintery and uneven fracture; is dull, or has a glimmering lustre; and is translucent on the edges. It much resembles some felspars. It is infusible *per se* before the blow-pipe; and scarcely so hard as quartz. The colors are usually yellowish-brown, and gray; but sometimes black, and of a purple or bluish tint. Hornstone occurs in large masses and veins, often imbedded in limestone rocks; also pseudomorphous, and forming the petrifying substance of wood, shells, and madrepore. It is found in limestone in the Tyrol; in Cyprus, Hungary, and Sweden, forming veins, and sometimes

passing into flinty slate, or common quartz; in Bohemia, and at Schneeberg, in Saxony, in pseudomorphous crystals after calc-spar; in Cornwall and Devon, as at Herodsfoot mine, near Liskeard, and at Beeralston and Beerferris. On Helvellyn. At the Menai Strait. At Milltown, two miles south of Dublin.

Hornstone occurs pseudomorphous at Beeralston, Devonshire, in the form of octahedral fluor, or capping it.

Beckite, a dull reddish-brown mineral occurring in mamillated or botryoidal incrustations at Torquay, and in some of the Devonshire mines, appears closely allied to Hornstone.

FLINTY-SLATE :—

	<i>a.</i>	<i>b.</i>
Silica	96.50	61.24
Alumina	0.60	18.75
Magnesia . . . . .	...	4.91
Lime	0.22	0.05
Protoxide of iron	0.74	11.70
Soda . . . . .	...	2.59
Potash . . . . .	...	1.22
Carbon,	0.01	0.49
Water	1.25	...
	99.32	100.95

a, by Du Menil; *b*, from Osterode in the Hartz, by Schnedermann.

This is a compact slaty variety, of a grey, yellowish-brown, dark green, or sometimes black color; containing carbonaceous matter; and forming strata in limestone rocks. In composition it is very various, as will be seen by the above analyses. It sometimes passes by transitions into clay slate.

Lydian Stone or *Basanite*, the touchstone of the jewellers, is a velvety-black variety of the above; indistinctly slaty, with a flat conchoidal fracture.

Lydian stone seems to be identical with the *chrysites* of Pliny, so called from its use in testing gold. It is applied to a similar purpose at the present day; the metal being drawn across the stone, and the trace it leaves either assayed by acid, or simply held to indicate by its color the fineness of the alloy.

Lydian stone occurs at Leadhills; at the Braid and Moorfoot Hills, near Edinburgh; at Glass Drummond, Downshire. At Carlow. It is common in Bohemia, Silesia, Hungary, and many other countries. At Elfdal it is manufactured into vases and other ornaments.

Between quartz and opal certain siliceous minerals seem to be intermediate, which, according to Fuchs, are an intimate mixture of crystalline and amorphous silica, from which the amorphous, or, in other words, the opalline portion, may be separated by a solution of caustic potash. Among these minerals chalcedony and flint hold a prominent position.

CHALCEDONY.

CHALCEDONY.—Kalzedon, *Werner*. Quarz Agathe Calcedonie, *Havy*. Calcedonie, *Breithaupt*.

Silica	84.0
Alumina	16.0

100.0 from Farøe by
 ——— Bergmann.

Sp. Gr. about 2.6

Chalcedony occurs botryoidal, reniform, stalactitic, and pseudo-morphous; but never crystallized. The color, which is usually uniform, presents various shades of white, grey, yellow, brown, red; more rarely blue, lavender, and green. It is generally semi-transparent; has a subdued waxy lustre; and an even, or flat conchoidal fracture.

It is named from the town Chalcedon, in Upper Asia, where it was collected by the ancients. The rocks near this place, which is not far from the present Scutari, contain chalcedony in considerable abundance. Splendid specimens in stalactitic and arborescent forms were formerly found in Trevascus mine, Cornwall: Iceland, and the Farøe Islands, where it occurs in amygdaloidal rocks, are now, however, its best known localities. Fine specimens of various colors, some of them containing impressions of crystals, have lately been brought from Uruguay, in South America. It also occurs at Oberstein, in the Palatinate; Siberia, sometimes in fine blue botryoidal specimens; Transylvania, Huttenberg and Loben, in Carinthia, Hungary, Mount Olympus, Tyrol, Bohemia; with bitumen at Pont du Chateau, Auvergne; in several parts of India; in Ceylon; and at the following British localities:—

Cornwall; at Ponsanooth and North Pool mines, in very fine specimens. Smalt-blue at Pednandrea. At Botallack. Formerly at Wheal Alfred. Blue and hydrophanous at Wheal Maudlin, Liskeard. Coraloidal at Redruth.

Devonshire; at Haytor iron-mine, and near Sidmouth. At Blackdown as petrified snails and mussels.

Dorset; at Charmouth.

Cumberland; at Caldbeck Fells, Silvergill, and Roughtengill.

Isle of Wight; at Undercliff, and Sandown, and Brixton Bays.

Yorkshire; at Whitby, and on the beach about 3 miles south of Scarborough.

Scotland.—Grey, with pitchstone, in the Isle of Rum, Argyllshire. In Walls, Orkney. At Allan Bank, East Berwick. As fossil wood

at Craigeleith quarry, near Edinburgh. At the Pentland Hills. At Carlops, of a lavender color, in thin veins. On the coast near Kinghorn, Fifeshire, and at Tayport, near Dundee, at both places of a bright red, in trap. In several of the Western Islands.

Ireland.—White and hydrophanous near Giant's Causeway, Antrim. On the shores of Lough Neagh, (also Armagh, Tyrone, and Londonderry). At Cloghan, Donegal. At Lambay, Dublin Co.; Londonderry; parish of Balteagh. Mammillated, and on pearl spar, at the junction of the trap and chalk, at Smulgedon, near Dungiven; at the White Mountain, and Slieve Gallion.

Many of the antique seals of Assyrian workmanship in the British Museum, and other collections, are of purple chalcedony, from some locality unknown.

Localities of Pseudomorphous chalcedony :—

Cubic, in the form of fluor :—in fine smalt-blue crystals at Tresztyan in Siebenburg; Kapnik, Hungary; and Schneeberg, Saxony.

In the form of calcite :—At Schneeberg, Saxony; in Iceland; in rhomboids and six-sided plates, near Penzance and St Just, Cornwall. Very beautifully at Haytor iron-mine, Devonshire.

In the form of spathic iron? :—at Hoy, Orkney.

In the form of pearl-spar, and also coating it :—at St Just and at North Roskear, Cornwall.

In the form of tabular crystals of barytes :—in fine specimens, at Herodsfoot, near Liskeard, and at Wheal Mary.

In the form of datholite :—Devon, at Haytor iron-mine, a variety known as *Haytorite* :—this variety has also occurred at North Roskear mine in small crystals.

MOCHA-STONE. *Dendrachates, Pliny.*

This is translucent white chalcedony, with dark moss-like markings produced by the infiltration of iron or manganese. It is identical

with the *dendrachates* of Pliny; and is beautifully described under that name in the Orphic poem. Arabia, and Cambay in India, are its best known localities:—it is also met with in Wicklow. There is a very fine series of Mocha-stones in the British Museum.

CHRYSTOPRASE.—Chrysoprase, *Lehmann*. Krisopras, *Werner*.
Chrysoprasus, *Pliny*?

Silica	96·16
Oxide of nickel	1·00
Lime, magnesia, alumina, and oxide of iron,	} traces

97·16 Klaproth.

Chrysoprase* is translucent chalcedony of a bright apple-green color, with an even, or slightly conchoidal fracture. Before the blow-pipe it loses its color, and becomes opaque. The color is derived from oxide of nickel.

Lehmann was the first in modern times who gave to this stone the name chrysoprase: he considers it identical with the mineral described under that name by Pliny, as resembling in color the juice of the leek, but with somewhat of a golden tinge.

When chrysoprase is highly translucent, and of a uniform color, it is much valued as an ornamental stone; unfortunately, however, it sometimes loses its intensity of color, particularly if kept in too warm a place. Occurs extensively in the neighbourhood of the towns of Rosemütz, Glassendorf, and Grochau in Lower Silesia; also at New Fane, in Vermont, North America: in both places in serpentine.

* From Gr., *Chrysos*, golden; and *prason*, a leek, in allusion to its color.

PLASMA :—

This is chalcedony of a leek-green, or sometimes grass-green color, sprinkled with whitish or yellow dots; faintly translucent; and with a vitreous, or glistening lustre. The coloring ingredient has not been satisfactorily ascertained.

This variety is not clearly described in any of the works of the ancient naturalists; although it may be included in Pliny's description of *smaragdus*: there are, however, in collections many engraved specimens regarded as antiques, hence its modern name; *plasma*, in Greek, signifying *engraving*.

Plasma is found of great beauty on Olympus; also in the Sierra de Guadalupe in Spain; in Moravia, and Bavaria; in the Schwarzwald, near Baden, and the Hauskopf, near Oppenau. Specimens are occasionally found among the ruins of Rome, from some unknown locality. It occurs also in India and China, whence it is brought to this country in the form of beads and other ornaments.

CARNELIAN.—Karneol, *Werner*. Quarz agathe cornaline, *Hauy*.

Carnelian is properly applied only to the blood-red variety of chalcedony, but popularly to the yellow, brown, and white varieties also, when of uniform color. The name is derived, in allusion to the color, from *caro-carnis*, Latin, signifying *flesh*. The color is often artificially produced:—in the red varieties by exposing them first in the sun for some weeks, then to heat in earthen pots:—in the yellow, by treating them with carbonate of soda at a high temperature.

A great number of engraved carnelians have come down to us from the ancients, this having been the stone most generally employed for that purpose.

In a specimen from the Gobinkoi Steppe in China, Heintz found in 100 parts, 0.081 alumina, 0.050 peroxide of iron, 0.028 magnesia, 0.004 potash, 0.075 soda, 0.003 carbon, and 0.391 water;—by which it would seem that the color is due to peroxide of iron.

Carnelian is found chiefly in the sandy plains of Asia Minor, Persia, Arabia, Cambay and Surat in India, Surinam, Ceylon, Java, and Siberia ; also in Bohemia, Saxony, Hungary, and the Island of Corsica ; in nodules generally of a dark grey color. These are imported into this country when their colors are artificially altered as stated above. Carnelian occurs fibrous in Hungary.

British localities :—Carrock Fells and Falcon Craig, Cumberland. On the beach about 3 miles south of Scarborough; similarly at many places on the south coast of England, as, at Chesil Bank, S. Dorset ; at Ventnor, Isle of Wight; at Peel Bay, Isle of Man; on the coast of Flintshire. In Perthshire; at Burn Aune, near Galston, Ayrshire ; and at several of the localities where agate is met with.

ONYX :—

Onyx consists of chalcedony in alternate parallel layers, usually brown and white; and is that variety generally used in the formation of cameos. Specimens in which some of the layers are black are sometimes sold by lapidaries under the name of Arabian onyx, but this color is artificially produced by boiling the stone, first in oil, and then in sulphuric acid. The oil imbibed by the porous portions of the stone, becomes carbonized by the action of the acid, thereby increasing the contrast of the different layers, and producing an onyx-like appearance.

This stone was much used by the ancients in the formation of cameos; and many finely-executed works of the kind have come down to us, proving in their lapidaries no inconsiderable degree of skill. One of the most celebrated is the Mantuan vase at Brunswick, which is about seven inches high, by two and a-half across, and is one of the largest cameos in existence. The figures, which are admirably executed, represent Ceres and Triptolemus in search of Proserpine.

Those specimens in which one or more of the layers is of a red color, are called *sard-onyx*.

Onyx occurs in abundance, and in large fragments, in the deserts of the Nagai Khirghiz, where it is collected ; also in Yemen, according to Niebuhr ; among the ruins of Babylon ; in fine specimens in Farøe and Iceland in the cavities of trap ; and at many of the localities where the following variety is met with.

AGATE.—Achates, *Pliny*.

This is chalcedony, often mixed with jasper, amethyst, or common quartz, in alternating irregular layers of different colors ; also in clouds or spots. It is formed by successive depositions of silica around the interior of the vesicular cavities of amygdaloidal rocks. The layers of which it is composed are sometimes of such extreme thinness that 100 may be counted within the space of a quarter of an inch. These layers are more or less porous : those which are transparent less so than the others. This may be seen in some polished specimens by breathing on them : the moisture disappearing sooner from the opaque than from the transparent layers. Some specimens are found to increase in weight as much as one per cent. after immersion in water, or, in other words, to absorb about 1-40th part of their bulk.

Owing to its beauty, variety, and capability of receiving a high polish, agate is much used as an ornamental stone ; and occupies a distinguished position in most collections. It receives different names according to the character of its markings, such as, fortification-agate, when the parallel lines are so disposed as to resemble the angles in the bastions of a fortification ; moss-agate, containing delicate moss-like ramifications of various colors ; ruin or breccia-agate, when the agate has evidently been broken up, and the fragments confusedly united by the means of calcite, common quartz, or other natural

cement; eyed-agate, ribbon agate, and so forth. It sometimes occurs hollow, having the interior lined with crystals of colorless quartz, amethyst, &c.

This stone was called *achates* by the Greeks, on account of the river Achates in Sicily being the locality whence specimens were originally brought. The ancient naturalists have distinguished its several varieties by the following appropriate names:—*Sardachates* was composed, in part, of sard or carnelian; *leucachates* was, as its name imports, of a white color; *coralloachates* was so called from some resemblance it bore to coral; *haemachates*, sprinkled with spots of blood-red chalcedony, was the variety formerly called St Stephen's-stone.

Agates sometimes occur of a very large size:—there is one in the imperial cabinet at Vienna formed into an oval dish twenty-two inches in length. In Germany large agates are made into mortars for chemical purposes; and according to Pliny they were employed for the same purpose by the physicians of his day.

Moss-agate is chalcedony containing delicate arborescent ramifications of various colors.

Large and fine agates are found in the trap rocks of Oberstein:—some are hollow, and lined with crystals of amethyst. Fine specimens are also found in Saxony, sometimes presenting a brecciated structure. At Kunnersdorff, in Bohemia, Italy, Sicily, Silesia, Sardinia, Arabia, Surinam, and many parts of India; very fine on the N.W. shore of Lake Superior; in Uruguay, South America, in fine specimens of a brownish color, generally combined with onyx.

The following are the principal British localities:—

Cornwall; in quartzose rock on S.E. part of Carnbrae Hill; at Kynance Cove, or the Devil's Bellows, one mile N.W. of Lizard Point.

Cumberland; at Carrock Fells and Falcon Craig.

Gloucestershire; in trap at Micklétton.

Staffordshire ; in gravel near Lichfield.

Scotland ; at Jedburgh, Roxburghshire. At Carlops, Pentland Hills, Peeblesshire. At Burn Aune, Galston, in fine specimens of a bright lemon-yellow, and mottled, also at Dunure, and along the coast, Ayrshire. Near Habbie's Howe, Edinburgh. In the rocks at St Cyrus and St Cyp, near Montrose, Forfarshire. Very fine, red and mottled, at Dunglass, Haddingtonshire. Near Stonehaven, Kincardineshire. Very fine at Kinnoul Hill, near Perth, accompanied by sardonyx, and in the bed of the Tay thereabouts. Fife, near Kinross. Dunnegan Head, Isle of Skye, accompanied by onyx, grey, and sometimes hollow. Hollow agates, containing loose nodules of calcite which rattle when the specimen is shaken, are found loose in the soil in Fifeshire.

In Scotland agates are commonly called "Scotch pebbles;" and though they are of a smaller size than those from some other localities, and often contain flaws; yet, on account of their variety of color and delicate markings, they are probably more beautiful than those found elsewhere.

Ireland ; Antrim ; on the coast near Ballycastle ; also on the shores of Lough Neagh, accompanied by onyx. Donegal ; near Malin Head, at the entrance into Lough Swilly, also at Clonca, on the coast. Red agates occur in Wicklow.

There is a fine series of specimens illustrating the formation of agates in the collection of Professor Heddle of St Andrews ; and another in the Museum of Economic Geology, Jermyn Street, London.

Jasper-agate, the *iaspachates* of Pliny, is applied to those varieties in which agate and jasper are so intimately combined as to render it impossible to determine with which they should be classed. Very fine specimens are found at Burn Aune, near Galston, Ayrshire. It also occurs at Dunglass, Haddingtonshire. In amygdaloid in Donegal ; at Lambay, Co. Dublin ; at Brayhead in Wicklow.

HELIOTROPE or BLOODSTONE.—*Heliotropium, Pliny.*

This is chalcedony intimately mixed with green-earth, which imparts to it a deep green color. The blood-red spots specimens often contain are produced by oxide of iron; and the name bloodstone is properly applied only to these specimens. It loses its color by heat. Among lapidaries the stone is in considerable request.

Heliotrope was known to the ancients, and Pliny speaks of it as a stone used in solar observations; whence he derives its name; *helios*, in Greek, signifying the sun, and *trope*, a turning.

The finest heliotropes are brought from the southern parts of Asia. They are likewise found in Bohemia, the Fassa Valley, Sicily, Sardinia, Transylvania, Bucharia, Tartary, Siberia, Iceland; in veins in slate at Bloomingrove, Orange Co., New York; also in Scotland, though of inferior beauty, in the Island of Rum, and Mull of Cantyre, Argyllshire.

A beautiful variety is brought from India, consisting of green chalcedony, more or less translucent, diversified with streaks of bright red, and sometimes yellow. It appears to have much the same composition as common heliotrope.

FLINT.

FLINT.—*Feuerstein, Werner. Quarz agathe pyromaque, Haüy. La Pierre à Feu, Breithaupt. The Lapis vivus of Pliny.*

Sp. Gr., about 2.59.

Flint consists, according to Klaproth, of about ninety-eight per cent. of silica, with minute portions of oxide of iron, lime, alumina, and water. Its colors, which are always dull, are greyish-white, grey,

or greyish-black, also yellow, red, and brown; sometimes in clouds or spots; and, rarely, in stripes.

The exterior coat is generally white, and, according to Vauquelin, contains from 5 to 10 per cent. of carbonate of lime. Flint is translucent; has a resinous, or dull lustre; and a perfect conchoidal fracture. It is infusible *per se* before the blow-pipe, and becomes opaque and white when submitted to heat. Specimens that have been for some time exposed to the air become less brittle than when first taken from their native bed.

Flint occurs in nodules of an irregular, or globular form, arranged in layers which are distributed in extensive horizontal beds through the upper chalk formation. It sometimes also forms thin veins filling up fissures and interstices of the chalk. The nodules are partly chalcidonic, and frequently contain cavities lined with crystallized quartz. Flint commonly contains specimens of fossil corals, shells, sponges, and remains of extinct animals which can live only in salt water. Many of these are of minute size, and can only be seen by examining their splinters under the microscope.

The siliceous earth constituting the substance of flint was once, according to Dr Mantell, in a state of complete solution in a sea inhabited by shells, echini, fishes, corals, sponges, and other zoophytes, and was precipitated into the chalk before the latter was consolidated.

Flint was at one time largely made use of in the form of "flints" for fire-arms; but since the introduction of percussion caps its use has been restricted to the manufactures of glass and pottery.

It is common in the chalk formation of northern Europe, including that of England and the north of Ireland; in the Apennine limestone of Italy; in Spain, near Madrid, and the mountains of Jaen; in Palestine, and other countries.

Plum-pudding stone, consisting of flints imbedded in an indurated siliceous paste, usually of a light yellow color, occurs in some parts of Devonshire. When polished it often forms handsome cabinet specimens.

O P A L.

OPAL.—Opal, *Werner*. Quarz résinite, *Hauy*. Uncleavable quartz, *Mohs*. Silex Opale, *Breithaupt*. Opalus, *Pliny*.

Sp. Gr. 1.9 to 2.4.

H. = 5.5 to 6.5.

Opal differs from quartz chiefly in containing from 3 to 13 per cent. of water. This water, however, is thought by Berzelius to be hygrometric, and therefore to vary slightly according to the state of the atmosphere. Opal is amorphous, or occurs in small reniform, botryoidal, and stalactitic forms, and large tuberoso concretions; is translucent to opaque, and brittle; with a conchoidal, or even fracture, and a vitreous to resinous lustre. It is colorless, or white, yellow, red, brown, green, grey, and occasionally black. Some varieties exhibit a beautiful play of prismatic colors, which is destroyed by heat;—others have different colors by refracted and reflected light. Before the blow-pipe decipitates and gives out water; but is infusible. Is almost quite soluble in a cold solution of caustic potash.

Opal occurs in short irregular veins in porphyry; also in the vesicular cavities of amygdaloidal rocks,—and sometimes in metalliferous veins.

The following varieties have been distinguished :—

PRECIOUS OPAL.—Noble Opal. Edler Opal, *Werner*. Quarz
résinite opalin, *Hauy*. Paederos, *Pliny*.

Silica	90
Water	10

—
100 from Czerwenitza
— by Klaproth.

Sp. Gr. 2·25 Beudant.

This variety of opal, on account of its great beauty, is the one most generally known. It is brittle; has a conchoidal fracture; is translucent or semi-transparent, and has a vitreous to resinous lustre. It is white, bluish, or yellowish-white by reflected light, and generally yellow by transmitted light. It exhibits brilliant and changeable reflections of prismatic colors in flashes; and sometimes the interior of the stone seems filled with colored light. This play of colors has not been satisfactorily accounted for:—Sir David Brewster, from numerous experiments, supposes it is owing to the refraction and reflection of light in certain very minute openings or pores in the interior of the mass, which are not cracks or fissures, but possess an uniform shape.

Precious opal sometimes loses its play of colors, and even falls in pieces, if kept in too warm a place;—this is attributed to its losing some of the water essential to its composition.

Precious opal, when it possesses vivid colors, is a gem of considerable value, and highly prized by the lapidary. It is usually cut *en cabochon*, this form being the most suitable for displaying its colors. It is

often imitated in glass, the prismatic changes of color being, in a manner, produced by a small per-centage of oxide of tin, but may be readily distinguished by its inferior specific gravity.

Precious opals of a large size are extremely rare ;—it is only after working for years that one of the size of a shilling, and of proportionate thickness, is found. There was at Kaschau a very fine one, of the size of a half-crown piece, which was valued at about £3000. The largest known mass is that in the Imperial Cabinet of Vienna. It is five inches long, by two and a-half wide, and weighs, according to Beudant, 17 ounces ; but it is not entirely disengaged from the matrix, and contains several flaws. This celebrated stone has been known at Vienna for between two and three centuries, but whence originally obtained is uncertain.

A semi-transparent variety occurs in Hungary, of a beautiful lavender color, which exhibits pale orange, the complimentary color, by transmitted light.

Precious opal was known to the ancients, and is that mineral compared in the Orphic poem to the delicate complexion of a lovely youth. It is well described by Pliny, who ranks it, on account of its great value, in the first class of gems. He says the Indians imitated it so well in glass that the counterfeit could hardly be detected. There are very few engraved specimens preserved in collections, consequent on its extreme brittleness preventing the free use of engravers' tools ;—that it was sometimes used as a ring stone, however, we learn from Pliny, who tells us of a senator named Nonius, who, possessing an opal which Antony coveted, was proscribed in consequence, and fled, saving of his whole fortune this ring alone. Pliny says this opal was still to be seen in his time, and, though no larger than a nut, was valued at 2,000,000 sesterces ;—probably equal to nearly £18,000 of our money.

Precious opal occurs in small masses, accompanied by common

opal, imbedded in a cellular porphyritic rock at Eperies and Czerwenitza, near Kaschau, in Hungary; at Freyberg, in Saxony; at Frankfort-on-the-Maine; in large and fine specimens at Gracias a Dios, in the province of Honduras, South America; also at Guatemala, Central America.

FIRE OPAL.—Girasol. Quarz résinite girasol, *Hauy*. Silex girasol, *Breithaupt*. Asteria, *Pliny*.

	<i>a.</i>	<i>b.</i>
Silica,	92.00	88.73
Water,	7.75	7.97
Perox. of iron, . . .	0.25	...
Alumina, . . . . .	...	0.99
Potash and soda, . .	...	0.34
Lime, . . . . .	...	0.49
Magnesia, . . . . .	...	1.48
	100.00	100.00

a, from Zimapan, Mexico, by Klaproth; *b*, from Farøe, by Forchhammer.

This is a semi-transparent variety of a dull yellow, or reddish color, which presents bright hyacinth-red and yellow reflections when turned towards the light.

This is the stone described by Pliny under the name *asteria*. He states that it came from India and Carmania, those from the latter country being preferred; and that it was difficult to engrave:—the difficulty arising, no doubt, from its brittleness, and from the numerous fissures it often contains.

Fire opal occurs at San Miguel, and Zimapan in Mexico; in Washington Co., North America, in good specimens; in Farøe, according

to Dr Heddle, on a hill above Quivig, in Stromoe, and at Lambavig in Oësteroe; in the Azores; at Czerwenitz, in Hungary, associated with precious opal; and has been found in Cornwall at Huel Spinster; Huel Gorland; Rosewarne copper mine; and of a light color and semi-transparent near St Just.

HYALITE.—Müller's Glass. Quarz hyalin concretionné, *Hauy*. Gummistein.

	<i>a.</i>	<i>b.</i>
Silica,	92·00	96·94
Water,	6·33	3·06
Alumina,	trace	...
	98·33	100·00

a. from Frankfort, by Bucholz; *b.* from Bohemia, by Damour.

Sp. Gr. 2·4.

H. = 7.

Hyalite occurs in small colorless, or white, botryoidal masses, resembling melted glass. It is brittle; has a highly vitreous lustre; and is infusible *per se* before the blow-pipe. It is found chiefly in the cavities of trap rocks; and occurs in amygdaloid, near Frankfort-on-the-Maine; on the Kaisertuhl, in the Breisgan; at Schemnitz, in Hungary, imbedded in clinkstone; at Waltsch and other places in Bohemia; in Silesia, Moravia, Mexico; in several parts of the United States; in Co. Down, Ireland, in well-defined specimens at Donald's Hill, forming a mammillated coating of concentric layers in the cavities of a soft claystone amygdaloid, and occasionally studded with small crystals of Arragonite; sometimes coating granite as a thin mammillated crust, white, translucent, and pearly; and also pearly and iridescent at Quarus, south of Newcastle.

COMMON OPAL.—Gemeiner opal, *Werner*. Quarz resinite common, *Havy*. Silex resinite, *Breithaupt*.

Common opal occurs chiefly in irregular masses, and presents various shades of white, bluish-white, yellow, red, brown, and green, without reflecting prismatic colors. It is sometimes stalactitic; also pseudomorphous in the forms of calcite, augite, &c. It has a vitreous to resinous lustre; a conchoidal fracture; and is translucent to opaque. Specimens vary much in chemical composition.

In Farøe a translucent green variety, colored by green-earth, occurs in small quantities; also a pale bluish-white translucent variety, which in thin fragments presents a brilliant wine-yellow iridescence by transmitted light.

Common opal is found at Telkobanya, Peklin, and elsewhere in Hungary, forming short irregular beds traversing porphyry; of a sap-green color at Climbach, Hesse; at Baldissero, Piedmont; in Farøe, in the cavities of amygdaloidal rocks; in Iceland; at Guadaloupe, Mexico, sometimes of an olive-green color; at Hrubshitz, Moravia, pseudomorphous after asbestos, fibrous, with a chatoyant lustre; in Cornwall, at Huels Stennach and Spinster near St Day; at Roskear and Huel Rosewarne, in Camborne; at Huels Poligine, Buller, and Damsel; at Botallack, St Just—at several of which mines it occurs in very characteristic specimens. Scotland: in the Isle of Rum, and several of the Hebrides. Ireland: in Antrim, at the Giant's Causeway; in Rathlin Island; at Crossreagh, in the parish of Ballywillin, and at several places along the basaltic range of the N.-E. coast of Ireland, usually white, sometimes yellowish and opaque; at Sandy Braes, of different colors, in pitchstone porphyry, and sometimes slightly opalescent.

WOOD-OPAL.—Lithoxylite. Holz-opal, *Werner*. Quarz resinite xyloide, *Havy*.

Silica,	93·00
Water,	6·13
Alumina,	0·13
Perox. of iron,	0·38

99·64, by Brandes, from
 ——— Oberkassel.

This variety presents several shades of white, grey, yellow, brown, and black; and different parts of the same specimen have often totally different appearances. It has a conchoidal fracture, with a resinous to waxy lustre; and is translucent to opaque. It is sufficiently distinguished by its ligneous appearance, and in most specimens the form and texture of wood are distinctly visible. The variety termed *wax-opal* occurs in very characteristic specimens at Libethen in Hungary.

Wood-opal is abundant in Hungary at Kremnitz, Libethen, Jasztraba, Saiba near Neusohl, and Telkobanya, sometimes forming large trees in pumice conglomerates; also in Bohemia; in the Sieben Gebirge; in great abundance near Hobart Town in Tasmania; in trap rocks in Transylvania and the Faröe Islands; in Antigua; and other trap countries.

SEMI-OPAL.—Halb-opal, <i>Werner</i> .	Quarz resinite hydrophane,	
<i>Hawy?</i>	<i>a.</i>	<i>b.</i>
Silica,	82·75	85·00
Water,	10·00	8·00
Alumina,	3·50	...
Peroxide of iron,	3·00	1·75
Carbon, . . . . .	...	1·00
Bitumen, . . . . .	...	trace
Lime,	0·25	...
	99·50	95·75

G

a, from dolerite at Steinheim, near Hanau, by Stucke ; b, by Klaproth.

This variety differs from common opal in being dull and opaque ; —some specimens, however, are rendered translucent by immersion in water, especially when in thin fragments. The fracture is flat conchoidal, and sometimes splintery. It has most of the colors of common opal, and is associated with it in amygdaloidal rocks in Farøe, Iceland, &c. It also occurs near Frankfurt ; in Hungary, traversing porphyry ; in Cornwall, near St Ives and St Just ; at Huel Buller, near Redruth ; and at Oakhampton, near Dartmoor, in Devonshire.

CACHOLONG.—

Silica,	95.32
Water,	3.47
Alumina,	0.20
Potash,	0.07
Soda,	0.06
Lime,	0.06
Magnesia,	0.40

99.58 from Farøe by
 ——— Forchhammer.

Sp. Gr. about 2.2.

Cacholong is dull and nearly opaque, with a glimmering lustre, and of a yellowish, or rarely, reddish-white color. It occurs in veins often interstratified with chalcedony. The exterior is frequently in a decomposing state, and is then white and opaque, adhering to the tongue from its strong disposition to absorb water. The name is Mongolian, meaning “beautiful stone.”

Occurs in loose masses of great beauty on the banks of the river Cach in Bucharia ; also in Farøe, Iceland, and Greenland. Ireland : in Ulster, at Smulgedon ; in Tyrone Co. in felspathic porphyry in the parish of Clogher ; and similarly at Barrack mountain, parish of Pomeroy.

HYDROPHANE.—Quartz resinite hydrophane, *Haüy*.

Silica,	93·13
Water,	5·25
Alumina,	1·62

100·00 from Hubertsburg,
 ————— by Klaproth.

This variety is closely allied to the former ; and also adheres to the tongue from its disposition to absorb water. It is opaque ; but gradually becomes transparent when immersed in water, emitting at the same time streams of minute air-globules, and becoming considerably heavier. This property is supposed to be owing to the mineral having become porous from long exposure to the atmosphere. Some specimens, after immersion, present the brilliant colors of precious opal. The name is derived from the Greek, *hudor*, water, and *ephane*, it shines.

Hydrophane occurs at Telkobanya in Hungary, Saxony, Iceland, Farøe, and Bucharia ; at Chatelaudren, in France, and Musinet, near Turin ; also in Ireland, near the Giant's Causeway, in small roundish masses of a brownish-white color in amygdaloid ; and at Crossreagh, parish of Ballywillin.

TABASHEER.—Vegetable opal.

This is a substance formed in the joints of certain kinds of bamboo, in the Birman Empire, many parts of Hindostan, and in

South America. It has the same composition as common opal, but is less hard, and more brittle. It is translucent to opaque; is bluish-white by reflected light, and hyacinth-red to wine-yellow by transmitted light. Specimens adhere strongly to the tongue; and when immersed in water become perfectly transparent, emitting at the same time streams of minute air-globules, and a strong siliceous odor. Tabasheer exists originally in the state of a transparent fluid, which acquires by degrees the consistency of mucilage, and is eventually converted by gradual induration into a solid substance.

FERRUGINOUS OPAL. — Eisen-opal, *Hausmann*. Opal-jaspis, *Werner*. Jaspe-opal, *Breithaupt*. Jasper-opal, *Jamieson*.

Silica,	43·50	93·5
Water,	7·50	5·0
Perox. of iron, . . .	47·00	1·0
	98·00	99·5
	_____	_____

both from Telkobanya, by Klaproth.

Sp. Gr. about 2·5.

Ferruginous opal bears the same relation to common opal as jasper does to common quartz. It is opaque; has a flat conchoidal fracture; and occurs of deep shades of yellow, red, and brown. Some specimens bear much resemblance to jasper, but may be distinguished by their inferior hardness.

Ferruginous opal, when it consists largely of iron, is sometimes used as an ore of that metal.

It is found at Telkobanya, and Tokay in Hungary; in the Erz Gebirge; near Almas and Tökörö in Transylvania; and in several of the localities of common opal, often in imbedded masses in the altered

pumice of trachyte conglomerates; in Dominica; in St Helena; also in Cornwall, at St Just, and near Camborne; in Antrim at Sandy Braes; and in some parts of the west of Scotland.

MENILITE.—Quarz resinite subluisant braunatre, *Hawy.*

Silica,	85.5	
Water and inflammable matter,	11.0	
Alumina,	1.0	
Lime and oxide of Iron, . . .	traces.	
		97.5 Klaproth.

Menilite, so named from its locality, Menil-montant, near Paris, occurs in compact reniform, or flattened masses, of a brown or bluish-grey color. It has occasionally a slaty-structure; is opaque, or sometimes translucent; and has little lustre. It is found in beds of adhesive slate at Menil-montant, and, from the resemblance of some of its varieties to pitch, is sometimes called the *Pitchstone of Menil-montant*. Menilite is also met with, but of a lighter color, at St Ouen, and in the environs of Mans.

QUINCITE, *Berthier.*—Rose Opal.

Silica,	54.0	
Water,	17.0	
Protox. of iron,	8.0	
Magnesia,	19.0	
		98.0 Berthier.

Quincite occurs in small masses of a light carmine-red, or rose color, disseminated through a limestone deposit, near the village of

Quincey, France. The color, which is generally unequally diffused, is supposed to be derived from organic matter. Concentrated acids dissolve the magnesia and iron, leaving the silica in a gelatinous state. It is said also to occur in Mexico.

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Quarz hyalin enfumé,	10	Sard,	27
Quarz hyalin jaune,	10	Sardachates,	30
Quarz hyalin laiteux,	9	Sard-onyx,	29
Quarz hyalin rose,	9	Schwimmkiesel,	12
Quarz hyalin rubigineux,	17	Schwimmstein,	12
Quarz hyalin vert-obscur,	17	"Scotch Pebbles,"	31
Quarz hyalin violet,	7	Semi-opal,	41
Quarz jaspe,	18	Siderite,	11
Quarz nectique,	12	Silex girasol,	38
Quarz résinite,	35	Silex opale,	35
Quarz résinite commun,	40	Silex resinite,	40
Quarz résinite girasol,	38	Siliceous sinter,	14
Quarz résinite hydrophane,	43	Sinople,	17
Quarz résinite opalin,	36	Smoky quartz,	10
Quarz résinite subluisant braunatre, 45		Stalactitic quartz,	12
Quarz résinite xyloide,	40	Tabasheer,	43
Quincite,	45	Touch stone,	23
Radiated quartz,	11	Tuf du Geysier,	14
Rhombohedral quartz,	2	Uncleable quartz,	35
Ribbon-agate,	30	Vegetable opal,	43
Ribbon-jasper,	20	Veneris crines,	4
Rock crystal,	2	Venus'-hair-quartz,	4
Rose opal,	45	Violet quartz,	7
Rose quartz,	9	White-stone,	2
Rubasse,	4	Wood-opal,	40
Ruin-agate,	29	Yellow quartz,	10
St. Stephen's-stone,	30		

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